

CLAIMS

1. A gas sensor, comprising:

a heating element which contacts detection target gas mixed with the atmosphere containing moisture;

a power source device for supplying electric current to the heating element; and

an arithmetic unit for calculating humidity and concentration of the detection target gas based on output voltage from the voltmeter and outputting the calculated values, wherein the arithmetic unit calculates the concentration of the detection target gas by the steps of:

A) commanding the power source device to supply at least first current, second current and third current, the second and third current of which are larger than the first current, to the heating element successively in a step-like and sequential manner for a predetermined time period;

B) receiving from the voltmeter a first output value, a second output value and a third output value as the both-end voltages of the heating element for the first current, the second current and the third current, respectively, after elapse of the predetermined time period;

C) obtaining the ambient temperature from the first output value;

D) correcting the second voltage and the third

voltage using an equation for correcting the second output value and the third output value based on the obtained ambient temperature and a zero-point output given from the voltmeter when only dry air exists and an equation for correcting sensitivity of the heating element obtained in advance based on a known concentration of the detection target gas so as to obtain a first standardized output value for the second current and a second standardized output value for the third current;

E) calculating humidity using a humidity correlation function which uses parameters of the first output value and the difference between the first standardized output value and the second standardized output value; and

F) correcting zero-point fluctuation relative to the humidity obtained in step E) using a first humidity correction value correlation function which uses parameters of the first output value and the difference between the first standardized output value and the second standardized output value, and correcting sensitivity fluctuation relative to the humidity obtained in step E) using a second humidity correction value correlation function which uses parameters of the first output value and the difference between the first standardized output value and the second standardized output value.

2. The gas sensor of claim 1, wherein the arithmetic unit repeats the steps of A) through F).

3. The gas sensor of claim 1, wherein the first current is

1mA or lower.

4. The gas sensor of claim 1, wherein the parameters given to the humidity correlation function are calculated by multiplying the difference between the first standardized output value and the second standardized output value by the reciprocal of the first output value raised to a higher power.

5. The gas sensor of claim 4, wherein the reciprocal of the first output value is raised to the third power.

6. The gas sensor of claim 1, wherein the humidity correlation function is expressed by a cubic equation.

7. The gas sensor of claim 1, wherein a value obtained by multiplying the difference between the first standardized output value and the second standardized output value by the first output value raised to a higher power is used as a parameter for the first humidity correction value correlation function and the second humidity correction value correlation function.

8. The gas sensor of claim 7, wherein the first output value is raised to the third power.

9. The gas sensor of claim 1, wherein each of the first humidity correction value correlation function and the second humidity correction value correlation function is expressed by a cubic equation.

10. The gas sensor of claim 1, wherein the heating element includes:

a pedestal made of silicone;

an insulating layer provided on the pedestal;
a heating body provided on the insulating layer; and
a concavity formed below the insulating layer of the pedestal equipped with the heating body.

11. The gas sensor of claim 1, wherein the heating element has platinum thin film.

12. A fuel cell system, comprising:

the gas sensor of claim 1 for outputting hydrogen concentration;

a fuel cell for generating electricity using fuel of hydrogen; and

a control circuit for stopping hydrogen supply to the fuel cell when an output indicating hydrogen from the gas sensor exceeds a predetermined value.

13. The fuel cell system of claim 12, further comprising:

a flow path through which hydrogen is supplied to the fuel cell; and

a ventilator for ventilating a space including the flow path, wherein:

the control circuit controls the ventilator such that the ventilator ventilates the space when an output indicating hydrogen from the gas sensor exceeds the predetermined value.

14. The fuel cell system of claim 12 or 13, further comprising:

an air compressor connected with the fuel cell;

an air humidifier connected with the air compressor; and

a discharge passage through which air is discharged from the fuel cell, wherein:

the air compressor is controlled such that the air amount discharged through the discharge passage increases when the gas sensor detects that the hydrogen concentration within the discharge passage exceeds a predetermined value; and

the air humidifier is controlled such that a predetermined humidity can be maintained based on a humidity output obtained by through detection of the gas sensor.

15. An automobile, comprising:

a main body forming a vehicle compartment;

tires for supporting the main body;

a motor for driving the tires;

a fuel cell for generating electricity using fuel of hydrogen and for supplying electric power to the motor;

the gas sensor of claim 1 disposed in the upper region of the vehicle compartment to output hydrogen concentration; and

a control circuit for stopping hydrogen supply to the fuel cell when an output indicating hydrogen from the gas sensor exceeds a predetermined value.

16. The automobile of claim 15, further comprising a ventilator which is so controlled as to ventilate a space provided within the main body by the control circuit when an output indicating hydrogen from the gas sensor exceeds the predetermined value.

17. The automobile of claim 15, further comprising an alarm which is so controlled as to give a warning by the control circuit when an output indicating hydrogen from the gas sensor exceeds the predetermined value.

18. The automobile of claim 15, further comprising an air conditioner for controlling humidity in the vehicle compartment, wherein:

the control circuit controls the air conditioner such that humidity in the vehicle compartment can be optimized based on humidity output from the gas sensor.